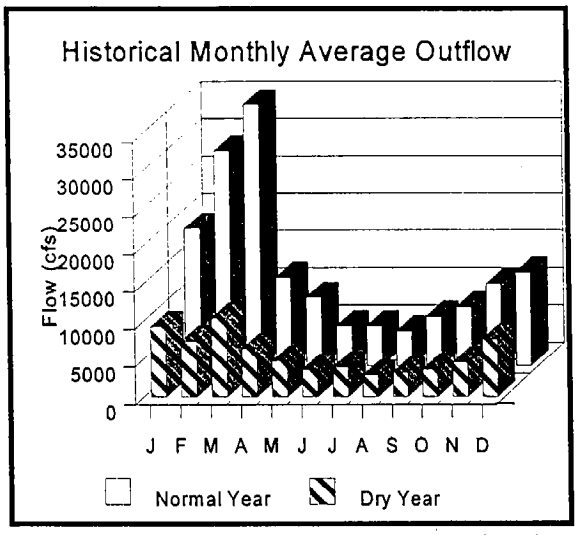
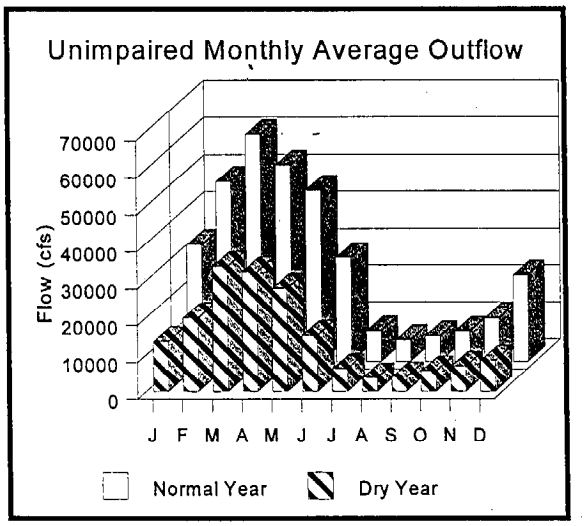
seasons. State Water Project (SWP) and Central Valley Project (CVP) pumping plants in the southern Delta can divert up to 11,000 cfs.



Historical Delta Outflow for 1972-1992 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

Natural floodplains and flood processes are the periodic flooding of the floodplain during peak flow events that would typically occur in late winter and spring of all but the driest years. Land reclamation and levee construction have eliminated much of the natural Delta floodplain, forcing waters rapidly to exit the Delta through confined channels. Only the Yolo Bypass and adjoining leveed islands are periodically flooded to help carry large flows coming down the Sacramento River.



Unimpaired Delta Outflow Estimated for Period 1972-1992 (Dry year is the 20th percentile; normal year is the 50th percentile or median year.)

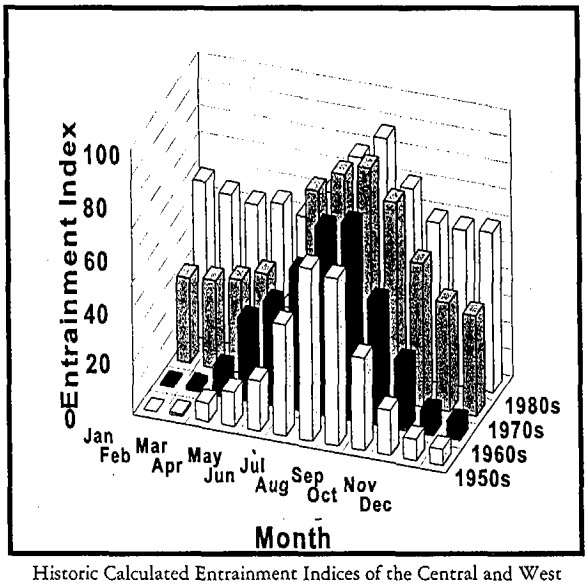
Reductions in spring freshwater flow into the Delta and the loss of riparian vegetative cover have led to slightly increased water temperatures in the Delta. Agricultural and other discharges into the Delta including power plant cooling water have also increased Delta water temperatures. Maintaining water temperatures in the Delta during the transitions in spring and fall is necessary to meet the needs of migrating salmon and steelhead passing through the Delta. Reduced March to May inflows and loss of riparian (waterside) and SRA habitats in the Delta have also contributed to higher water temperatures in the Delta.

Changes in Delta channel hydraulics (water flows) began in the mid-19th century with land reclamation that restricted flows to narrow channels of levees. Floodflows that once spilled into a vast floodplain are now confined to narrow channels. These same channels later became conduits for carrying water to water-export facilities in the central and south Delta. In 1951, the CVP began to transport water from the south Delta at Tracy to the Delta-Mendota Canal. That same year, operation of the Delta Cross Channel (DCC) began to allow Sacramento River water to flow through interior Delta channels to the south Delta export facilities at Tracy. South Delta export facilities were increased with the addition of the SWP pumping plant at Byron in the late 1960s. In 1968, the SWP began to transport Delta water through the California Aqueduct to southern California.

Existing hydraulic conditions inhibit the function of Delta channels as migration corridors and rearing habitat for salmon and other anadromous fish, including steelhead, striped bass, American shad, white sturgeon, and green sturgeon. Native resident fish such as delta smelt and splittail also depend on natural hydraulic processes, as hydraulic conditions determine physical habitat characteristics and foodweb (all of the food chains) production (i.e., by controlling the residence time of water in Delta channels). Natural hydraulic conditions benefit other resident freshwater and estuarine fish, including longfin smelt, tule perch, threadfin shad, white catfish, largemouth bass, and starry flounder. Low residence time in Delta channels and sloughs decreases biological productivity and habitat value.

Channel hydraulics once were relatively unaltered in the Delta. In November through March, an important period for aquatic species, hydraulic

changes were insignificant in the 1950s and 1960s, as measured using an indicator of hydraulic conditions provided by output from a particle transport model (DeltaMOVE). However, by the 1980s, there had been a dramatic increase in unhealthy channel hydraulic conditions in locations such as the Central and West Delta. Aquatic foodweb productivity in the Delta has declined over the past several decades and is the subject of ongoing focused research activities. The decline was caused by changes in freshwater inflow, Delta channel hydraulics (i.e., water residence time), water diversions, water quality, and the species composition of aquatic organism communities. Foodweb productivity, beginning at the primary production (i.e., plant cell production) level, is essential to provide enough food to maintain populations of important fish. Primary productivity in the Delta depends on spring flow events in dry and normal years. Spring flows deliver essential nutrients, increase residence time in channels and sloughs, and increase shallow water and wetland habitat.



Historic Calculated Entrainment Indices of the Central and West Delta Ecological Management Unit.

The loss of tidal marshes (historic tule marshes) to agricultural conversion probably constituted one of the greatest causes of loss of productivity and a change in the nature of the aquatic foodweb (i.e., a change from a detritus-based food web characteristic of marshes to a more phytoplankton-based food web). Along with the loss of tidal marshes in the Delta to land reclamation came the loss of shallow-water aquatic habitats (e.g., small sloughs, ponds). Many native resident and anadromous fish and estuarine

Species-Habitat Associations

Species	*Habitats*
Swainson's hawk	*Riparian/Agricultural*
Clapper rail	*Tidal emergent wetland*
Black rail	*Tidal Emergent wetland*
Sandhill crane	*Seasonal aquatic and wetland, agricultural, and grassland*
Riparian brush rabbit	*Contiguous riparian woodland*
Shore and wading birds	*Aquatic and wetland, seasonal aquatic, and agricultural*
Upland game birds	*Agricultural, riparian, and upland*
Waterfowl	*Tidal perennial aquatic, seasonal aquatic, riparian, agricultural, and wetland*
Neotropical migratory birds	*Riparian, grassland, agricultural land*
Delta smelt	*Shallow water, sloughs, bays*
Splittail	*Marsh, floodplain, sloughs*
Striped bass	*Shallow water, sloughs*

invertebrates depend on these habitats. Shallow-water habitats around the Delta provide spawning and rearing habitats for many native resident Delta fishes. They also provide important rearing and migratory habitats for many Central Valley chinook salmon and steelhead. Tidal perennial aquatic habitat benefits native waterfowl, wading and shorebirds, and wildlife, as well as native plants that depend on such habitats.

Lakes and ponds support simple invertebrate communities, riparian habitat, and wintering waterfowl. Examples of nontidal perennial aquatic habitats include the Stone Lakes in the North Delta Ecological Management Unit near Sacramento and the "blow out ponds," or ponds remaining after levee breaks on islands such as Venice Island and Webb Tract. Most ponds also support introduced species such as the bullfrog and largemouth bass, which

reduce the value of these ponds to special-status species such as the red-legged frog. Introduced species also reduce the habitat's value as brood water for nesting waterfowl. Such habitats within the Delta also benefit waterfowl, as well as many plant and wildlife species, including many rare or declining special status species.

After more than 100 years of land reclamation activities in the Delta, many linear miles of natural sloughs have been lost. Sloughs are important spawning and rearing areas for many native Delta fish species, as well as waterfowl and wildlife. Of those natural sloughs that remain, most have been severely degraded by dredging, levee confinement, loss of riparian vegetation, high water flow, infestation of water hyacinth, and poor water quality (i.e., many receive agricultural drain water).

Shoals are simple underwater islands or shallows in otherwise deeper channels of the Delta. Channel islands and shoals provide valuable fish and wildlife habitat within the confined reaches of Delta channels. Only "tule islands" or "berm islands" contain some original native Delta habitats. These islands are found in Delta channels where the distance between levees is wide enough that past dredging activities left a remnant strip where soils were deposited at an elevation high enough to support tules and cattails. Such islands generally have shallow water and SRA habitats, as well as tidal marsh and riparian habitats. The number and acreage of channel islands have declined over the past several decades from dredging, wave and wake erosion, and levee maintenance.

Tidal marshes, once the most widespread habitat in the Delta, are now restricted to remnant patches. A GIS analysis of 1906 U.S. Geological Survey maps determined the extent of change in tidal wetland since 1906. Extensive losses of tidal wetland habitats in three of the four Delta Ecological Management Units have exceeded 87,000 acres from 1906 to 1993. These losses represent only a portion of the change that have taken place since reclamation began in the mid-nineteenth century. It has been estimated that circa 1850, about 310,000 acres of the Delta consisted of tidal wetlands in a mosaic dominated by emergent vegetation, and included smaller tidal marsh drainage channels and open-water lakes and ponds (Atwater and Belknap 1980).

Nearly two-thirds of the reclamation of the Sacramento-San Joaquin Delta Ecological Management Zone for farmland occurred before 1906. Thirty percent of the lands reclaimed before 1900 were in the North Delta and East Delta Ecological Management Units, 38% in the South Delta Ecological Management Unit, and only 2% in the Central and West Delta Ecological Management Unit. Most of the remaining tidal wetlands lack adjacent upland transition habitat and other attributes of fully functioning tidal wetlands. This was caused by upstream water development, in-Delta export facilities, adjacent levee maintenance practices, agricultural practices, and urban and industrial development.

Tidal wetlands provide important habitats for many species of plants, waterfowl, and wildlife. In addition, wetlands provide an important contribution of plant (dead material) and nutrient recycling to the aquatic foodweb of the Bay-Delta estuary, as well as important habitat to some species of fish and aquatic invertebrates.

Seasonal wetlands include vernal pools, wet meadows or pastures, and other seasonally wetted habitats such as managed duck clubs in the Delta floodplain. Most of this habitat is located on leveed lands or in floodplain bypasses such as the Yolo Bypass. Such habitats were once very abundant during the winter rainy season or after seasonal flooding of the Delta. With reclamation, flooding occurs primarily from accumulation of rainwater behind levees, from directed overflow of flood waters to bypasses, or from flooding leveed lands (e.g., managed wetlands). Seasonal wetlands are important habitat to many species of fish, waterfowl, shorebirds, and wildlife.

Acres of Tidal Fresh Emergent Wetland (Marsh)

Ecological Management Unit	1906	1993	Percentage of change
North Delta	53,660	4,640	-91.3
East Delta	7,600	1,270	-83.3
South Delta	470	650	+38.3
Central and West Delta	37,170	5,040	-86.4
Total	98,900	11,600	-88.6

Upland habitats are found mainly on the outer edges of the Delta and consist primarily of grasslands and remnant oak woodland and oak savanna. Of these, perennial grasslands are an important transition habitat for many Delta wildlife species. They are also buffers to protect wetland and riparian habitats. Much of the grassland habitat adjacent to the Delta has been lost to agriculture (e.g., grain, vineyards, and orchards) and development (e.g., home construction, golf courses). Grasslands provide habitats for many Delta plant and animal species.

Riparian habitat, both forest and shrub, is found on the water and land side of levees, berms, berm islands, and in the interior of some Delta islands. This habitat ranges in value from disturbed (i.e., sparse, low value) to relatively undisturbed (i.e., dense, diverse, high value). The highest value riparian habitat has a dense and diverse canopy structure with abundant leaf and invertebrate biomass. The canopy and large woody debris in adjacent aquatic habitats provide shaded riverine aquatic habitats on which many important fish and wildlife depend during some portion of the life cycles. The lower value riparian habitat is frequently mowed, disced, or sprayed with herbicides, resulting in a sparse, habitat structure with low diversity.

Riparian habitat is used by more terrestrial wildlife species than any other Delta habitat type. From about 1850 to the turn of the century most of the riparian forests in the Delta were decimated for fuelwood as a result of the gold rush, river navigation, and agricultural clearing. Remnant patches are found on levees, channel islands, and along the margins of the Delta. Riparian habitats and their adjacent shaded riverine aquatic habitat benefit many species of fish and wildlife.

Inland dune scrub habitat is found in the south and west portions of the Delta in areas where wind-blown sand is deposited along margins of the Delta. Inland dune habitat has unique native plant communities including two special-status species. Much of the dune habitat has been lost to industrial and urban development.

Agricultural habitats also support populations of small animals, such as rodents, reptiles, and amphibians, and provide opportunities for foraging raptors. Nonflooded fields and pastures are also habitats for pheasant, quail, and dove. The Delta supports a variety of wintering and breeding raptors. Preferred habitat consists of tall trees for nesting and perching near open agricultural fields that support small rodents and insects for prey. Both pasture land and alfalfa fields support abundant rodent populations.

The Swainson's hawk, a raptor species listed by the State as threatened, breeds and occasionally winters in the Delta. One of the highest breeding densities of Swainson's hawks in the Central Valley is found on the eastern edges of the Delta, primarily along the upland margins in areas adjacent with pastures, alfalfa croplands, and grasslands. The present-day Delta is mostly farmland, occupying over 86% of the dry-land area. The wildlife habitat value of these lands depends on crop types and agricultural practices employed, including flooding and tillage regimes. The farmed "wetlands" of the Delta are important for wintering water birds, including shorebirds, geese, swans, ducks, and sandhill cranes, supporting 10% of all waterfowl wintering in the State. The value of agricultural lands to other migratory birds is much greater. For example, the Delta is extremely important for tundra swans and greater sandhill cranes. In average years, 70% to 85% of the tundra swans in the Pacific Flyway winter in the Central Valley; 90% of this use occurs in just eight counties with the Delta being a major use area.

Water diversions in the Delta divert up to 14,000 cfs of the freshwater inflow to the Delta. Though diversions vary seasonally, relatively high rates can occur in any month. Water diverted from the Delta is used throughout much of the central and southern portion of the State.

With many diversions unscreened or poorly screened great numbers of fish and aquatic invertebrates are entrained with the water. Lack of adequate screening and location of water diversions in sensitive areas of the Delta contribute to the loss of important fish and aquatic foodweb organisms.

Levee construction and bank protection have led to the loss of riparian, wetland, and shallow-water habitat throughout the Delta. Habitat on levees and shorelines needs improvement to restore the variety of species and ecological functions needed for aquatic and wildlife resources of the Delta.

Dredging and disposal of dredge materials have contributed to the loss and degradation of important

aquatic habitat and vegetated berm islands in the Delta.

Over the past several decades, the accidental introduction of many marine and estuarine organisms from the ballast waters of ships from the Far East has greatly changed the plankton and benthic (bottom and shore dwelling) invertebrates of the Delta with further effects up the foodweb. Further changes can be expected if restrictions are not made on ballast water releases into the San Francisco Bay and Delta. Other important routes for the introduction of invasive species include overland at border crossings, aquaculture operations, and commercial bait dealers.

The numbers of predatory fish have increased at certain locations in the Delta (e.g., Clifton Court Forebay, docks, piers, etc.) and losses of some resident and anadromous fish to predation may limit their recovery. Predators may reduce populations of important fish, including chinook salmon, steelhead, and delta smelt.

Large amounts of toxins continue to enter the Delta from municipal, industrial, and agricultural discharges. The toxins have demonstrated in bioassay potential adverse effect on the health, survival, and reproduction of many important Delta fish and their foodweb organisms. Toxins in the tissues of the fish are also a human health risk to people who eat Delta fish. Continued reductions of toxins from discharges and from releases of toxins from the sediment (e.g., those disturbed by natural forces and dredging) are essential to the restoration program.

The legal and illegal harvest of fish may limit recovery of some populations in the Delta and its watersheds. Harvest of chinook salmon, steelhead, and sturgeon in the Delta may affect recovery of these populations. Harvest enforcement and management help sustain important fish populations from overharvest.

Boat traffic in the Delta contributes to the erosion of remaining shallow water, riparian, and wetland habitat along Delta channels and degrades water quality from fuel and oil spills. High boat speeds and traffic endanger remnant habitat and limit the success of habitat restoration.

The delta smelt population of the Bay-Delta estuary is a federally listed threatened species. It depends on the Delta for spawning and rearing habitat. It lives in fresh and brackish bays and sloughs of the Delta. Delta smelt decline is related to poor habitat conditions during periods of drought, but are also adversely affected by water diversions throughout the Delta. Delta smelt benefit from high freshwater inflow, particularly during the late winter and spring of dry years. Their recovery depends on adequate slough and shallow water habitat, reduced effects of water diversions, and increased productivity of the aquatic foodweb.

The longfin smelt populations of the Bay-Delta live within the brackish water and saltwater of northern San Francisco Bay and migrate upstream into the Delta to spawn. The decline in the longfin smelt population has coincided with a number of changes in the estuary including: low flows in late winter and spring, reduced freshwater flows through the Delta and into Suisun Bay, water diversion (particularly in drier years), and contaminants.

Like delta smelt, splittail are a native resident species of the Delta and Bay that depend on the Delta for spawning, rearing, and feeding. The Delta splittail population declined during droughts but has rebounded in recent years. Splittail depend primarily on shallow water habitats for spawning including shorelines, sloughs, and aquatic habitats associated with wetlands and seasonal floodplains (e.g., the Yolo Bypass in the north Delta). The splittail population will benefit from improved wetland and slough habitat, a more productive aquatic foodweb, reduced loss to predation, improved estuarine hydraulics, and higher late-winter and spring freshwater flows during dry years.

White sturgeon and green sturgeon populations in the Central Valley use the Delta for migrating, feeding, and as a nursery area. Populations appear to be stable. Do to lack of specific data for green sturgeon, however, the implication that this species is stable may be inaccurate. Sturgeon benefit from high late-winter and spring freshwater inflow, a productive aquatic foodweb, and slough habitats in the Delta. Legal and illegal harvest and losses to water diversions may be limiting their abundance.

Four runs of chinook salmon use Central Valley waterways. All four runs depend on the Delta during at least a portion of their life cycle. The Delta provides migratory and rearing habitat for salmon in all but the warmest summer months. Tidal perennial

marsh habitat and adjoining sloughs and aquatic habitats in the Delta are important fry rearing habitats.

Many populations of chinook salmon have declined in recent decades. The decline was caused by a combination of ocean, river, and Delta factors. Reductions in freshwater flow through the Delta and increases in water diversions have led to declines in salmon populations. Improving late-winter and spring freshwater flows through the Delta and reducing losses to diversions are essential to the recovery of salmon. Chinook salmon also benefit from lower water temperatures in spring and fall, adequate aquatic habitats, and high foodweb productivity. Many juvenile chinook salmon are lost to water diversions and predators.

Steelhead usage of the delta-estuary is not well known and has not been studied. At the very least, they utilize the delta waterways for migration to and from the spawning and rearing tributaries. Generally, estuaries provide important - and on some small coastal tributaries, essential - rearing habitat for steelhead, but usage of the Sacramento-San Joaquin delta-estuary by steelhead for this purpose is unknown. Occurrences of juvenile steelhead are not uncommon at the CVP and SWP fish salvage facilities, but they are not salvaged in as great a number as are chinook salmon. This could reflect a much lower abundance of steelhead in the Central Valley system or it could be the result of the larger size of steelhead smolts, compared to salmon smolts, when they are emigrating to the ocean (larger fish are better able to avoid entrainment).

The striped bass population of San Francisco Bay and the Sacramento and San Joaquin rivers depends on the Delta for much of its life cycle. The Delta provides important spawning and rearing habitat for striped bass. Reductions in freshwater flow and increases water diversions have resulted in striped bass population declines over the past several decades. Poor water quality in the Delta may also be limiting the survival of young and adults. Striped bass also benefit from high aquatic foodweb productivity. Loss of tidal perennial aquatic, wetland, and slough habitats may also limit production of striped bass. Many striped bass young are lost in water exported through water diversions. Artificially rearing young striped bass salvaged at the south Delta pumping plant fish facilities or supplementing production with hatchery-reared fish may be necessary to sustain the population under present limiting factors.

American shad is an anadromous fish that spawns in the Sacramento River and its major tributaries. They pass through the Delta on their upstream spawning migration in spring. In the fall, young migrate through the Delta on their way to the ocean. A portion of the population spawns and rears in the Delta. Low productivity in periods of drought is a concern. American shad production increases with higher late-winter and spring freshwater flow through the Delta in dry and normal rainfall years. Improved aquatic foodweb production and lower relative export rates at water diversions will benefit American Shad.

Many native and non-native fish species are residents of the Delta. Resident fish populations, like delta smelt and splittail, will benefit from improved aquatic habitats and foodweb production. Many native fish species have declined gradually over the past century from loss of habitats and introductions of non-native fishes. More recently, native resident species have further declined from changes in freshwater flow, water diversions, poor water quality, and further non-native species introductions and habitat degradation. For many of these species, improvements in their native habitats such as sloughs and tidal marshes, is essential to their restoration. Native residents will also benefit from more natural freshwater flow patterns, improved water quality, and reduced losses to water diversions.

Bay-Delta aquatic foodweb organisms include bacteria, algae, zooplankton (e.g., copepods and cladocerans), epibenthic invertebrates (e.g., crayfish, Neomysis and Crangon shrimp), and benthic invertebrates (e.g., clams). Foodweb organisms are essential for the survival and productivity of fish, shorebird and other higher order animal populations in the Bay-Delta estuary. Some organisms are non-native species (e.g., certain zooplankton and Asian clams) that may be detrimental to native species and the foodweb in general. Recent declines in aquatic foodweb organisms of the Bay-Delta, particularly in drier years, has caused a reduction in overall Bay-Delta productivity. Important aquatic foodweb organisms include algae, bacteria, rotifers, copepods, cladocera, and mysid shrimp.

The western spadefoot and California tiger salamander occur throughout much of the Central Valley, San Francisco Bay, and coast ranges and foothills below 3,000 feet, as well as along the coast in the southern portion of the State. Declining populations have warranted their designation as species of special concern and species of concern by the California Department of Fish and Game (DFG) and U.S. Fish and Wildlife Service, respectively. Major factors that limit these resources' contribution to the health of the Delta are related to adverse effects of conversion of seasonal wetlands and adjacent uplands to other land uses and excessive mortality resulting from introduction of non-native predators and some land use practices.

The California red-legged frog is California's largest native frog. Its habitat is characterized by dense, shrubby riparian vegetation associated with deep, still, or slow-moving water that supports emergent vegetation. The distribution and population of this species has declined substantially, primarily as a result of habitat loss or degradation and excessive predation. The loss of habitat and declining condition of the species' population have warranted its listing as threatened under the federal Endangered Species Act and a Species of Special Concern by DFG. Major factors that limit this resource's contribution to the health of the Delta are related to adverse effects of the loss or degradation of critical wetland and riparian habitats and the introduction of non-native predators.

Once possibly abundant in the Delta, the giant garter snake and western pond turtle are now rare there. Improvements in wetland, riparian, and grassland habitats around the margins of the Delta could greatly benefit these species.

Once abundant in the Delta, Swainson's hawk is now rare. Improvements in agricultural and riparian habitats will aid in the recovery of the Swainson's hawk.

A long-term decline in emergent wetlands has reduced the population of California black rail in the Delta. Restoring emergent wetlands in the Delta should aid in the recovery of the California black rail.

The population of greater sandhill crane in the Central Valley has declined over the past century with the loss of permanent and seasonally flooded wetlands. Improvements in seasonally flooded wetlands and agricultural habitats should help toward recovery of the greater sandhill crane population.

Herons, egrets, and other shorebirds and wading birds breed and winter throughout the Central Valley and the Delta. Their populations depend on aquatic and wetland habitats. Shorebirds and wading birds will benefit from restoration of wetland, riparian, aquatic, and agricultural habitats.

The riparian brush rabbit is associated with riparian habitats of the Central Valley floodplain. It has been eliminated from the Delta from loss of riparian habitat. Elsewhere, the population and distribution of this species have declined substantially, primarily as a result of the loss or degradation of its habitat. The loss of habitat and declining populations have warranted its listing as endangered under the California Endangered Species Act.

The major factor that limits this resource's contribution to the health of the Delta is related to adverse effects of the historical loss and degradation of the mature riparian forests, on which the riparian brush rabbit depends, in the Delta and San Joaquin River floodplain.

Many species of waterfowl overwinter in the Delta and depend on high-quality foraging habitats to replenish their energy reserves. They depend on wetland, riparian, aquatic, and agricultural habitats. Many species of resident and migratory waterfowl will benefit from improved aquatic, wetland, riparian, and agricultural habitats.

Upland game species are of high interest to recreational hunters in the Bay-Delta and contribute to California's economy through the sale of hunting-related equipment and hunting-related expenditures. Major factors that limit this resource's contribution to the health of the Delta are related to adverse effects of conversion of native upland habitats for agricultural, industrial, and urban uses, and land use practices that degrade habitats used by these species.

Neotropical bird species breed in North America and winter in Central and South America. Many species of neotropical migratory birds migrate through or breed in the Bay-Delta. These species are a significant component of the ecosystem. These species are of high interest to recreational bird watchers, and contribute to California's economy through sales of

equipment and other bird-watching-related expenditures. There have been substantial losses of historic habitat used by these species and available information suggests that population levels for many of these species is declining.

Major factors that limit this resource's contribution to the health of the Delta are related to adverse effects of conversion of native habitats for agricultural, industrial, and urban uses, and land use practices that degrade habitats used by these species.

The Lange's metalmark and the delta green ground beetle, both federally listed endangered species, and the valley elderberry longhorn beetle (VELB), a federally listed threatened species, are respectively associated with inland dune, vernal pool, and riparian habitats. The distribution and populations of these species have declined substantially, primarily as a result of the loss or degradation of these habitats within their range. The loss of habitat and declining condition of these species populations have warranted their listing as threatened or endangered under the federal Endangered Species Act.

Major factors that limit this resource's contribution to the health of the Delta are related to adverse effects of conversion of native habitats for agricultural, industrial, and urban uses, and land and water management practices that degrade habitats used by these species.

Once abundant in riparian woodlands of the Delta, yellow-billed cuckoo have declined with the loss of riparian habitats there. The yellow-billed cuckoo will benefit from improvements in habitat that result from efforts to protect, maintain, and restore riparian and riverine aquatic habitats throughout the Delta.

List of Species to Benefit from Restoration Actions in the Delta Ecological Management Zone

- delta smelt
- longfin smelt
- green sturgeon
- Sacramento splittail
- chinook salmon (all runs)
- steelhead trout
- lamprey (all species)
- California black rail
- Swainson's hawk
- special status plant species
- Sacramento perch
- riparian brush rabbit
- greater sandhill crane
- western yellow-billed cuckoo
- California red-legged frog
- western pond turtle
- Lange's metalmark butterfly
- native resident fishes
- migratory waterfowl
- shorebird guild
- wading bird guild
- neotropical migratory bird guild
- Bay-Delta foodweb organisms
- white sturgeon
- striped bass
- American shad
- non-native warmwater gamefish
- upland game

Descriptions of Ecological Management Units

North Delta Ecological Management Unit

The North Delta Ecological Management Unit is bounded on the south and east by the Sacramento River. Notable features are the Yolo Bypass, the Sacramento deep water channel, the Cache Slough complex, the Sacramento River and adjoining sloughs, the Snodgrass Slough and Stone Lakes complex, and the Delta Cross Channel (DCC) gates which, when open, allow Sacramento River water to flow into the forks of the lower Mokelumne River. Land elevations generally range from 5 feet below to 10 feet above mean sea level.

The size of the unit is approximately 235,000 acres. As with the Delta's other units, the primary land use is agriculture with more than 60% or 141,000 acres in field crops, orchards, and vineyards. Approximately 5% of the unit consists of riparian, oak woodland, freshwater marsh, and seasonal wetland. (See tables in this section.) Much of the permanent and seasonal wetland habitat is found in the Yolo Bypass, Cosumnes River Preserve, and Stone Lakes area.

Hydraulic processes in the North Delta Ecological Management Unit are influenced by tides, upstream water releases, weather, channel diversions, and river inflow. Unimpeded tidal action into tidal wetlands affects sediment and nutrient supplies into those wetlands and natural marsh successional processes. Tidal action and floodwater discharges from the rivers and Yolo Bypass transport nutrients and organic carbon into aquatic habitats of the Delta and San Francisco Bay.

Hydraulic processes have been modified in the North Delta Ecological Management Unit since the 1890s. Reductions in flow from the Mokelumne River began in the early 1890s with diversions by the Woodbridge Irrigation District. Further diversions began with the completion of the Mokelumne River Aqueduct in the 1930s. Additional agricultural diversions from the river were developed in the 1960s when the present level of diversions from the Mokelumne River was reached. The construction of the Yolo Bypass significantly altered hydraulic patterns during above normal and wet water years. The DCC gates began operation in 1951 and increased the flow of Sacramento River water into the East Delta Ecological Management Unit and away from the mainstem Sacramento River below Walnut Grove.

Hydraulic patterns have been further modified by the significant export pumping beginning in 1951 for the CVP and in 1968 for the SWP. The Barker Slough pumping plant at the east end of Lindsey Slough in the Cache Slough complex was completed in 1988; it exports water directly from the North Delta Ecological Management Unit to the North Bay Aqueduct.

Current hydraulic conditions in the North Delta Ecological Management Unit affect the ability of this Ecological Management Unit to support channels with suitable residence times and natural net flows; to provide adequate transport flows to the lower estuary; and to support high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

The effects of many small unscreened diversions in the North Delta Ecological Management Unit are undocumented.

EAST DELTA ECOLOGICAL MANAGEMENT UNIT

The East Delta Ecological Management Unit is bounded on the northwest by the Sacramento River; on the northeast by the Mokelumne and Cosumnes rivers; and on the south by Highway 12, the South Fork of the Mokelumne River, White and Disappointment Sloughs, and the San Joaquin River. Notable features are Georgiana Slough, the DCC, the Cosumnes River Preserve, and the Woodbridge Ecological Reserve.

North Delta Ecological Management Unit Land Use

Land use	*Acres*
Non-flooded Ag	*118,011*
Flooded Ag	*14,528*
Orchard	*2,832*
Vines	*5,805*
Total cultivated	*141,176*
Grass	*42,194*
Other	*52,480*
Total	*235,850*

Land elevations in this unit generally range from 10 feet below to 10 feet above mean sea level with the western half of the unit ranging from 10 feet below to 5 feet below mean sea level and the eastern half ranging from 5 feet below to 10 feet above mean sea level. These elevations are generally higher that elevations in other regions of the Delta. Elevation is an important factor in evaluating the quality of habitats and in designing habitat restoration projects.

This Ecological Management Unit consists of more than 100,000 acres. It contains both forks of the Mokelumne River, the Cosumnes River, three dead-end sloughs (Beaver, Hog, and Sycamore), and important waterfowl wintering and sandhill crane foraging and roosting areas. As with the Delta's other units, the primary land use is agriculture with more than 68% in field crops, orchards, and vineyards. (See the table in this section for land use acreage.)

East Delta Ecological Management Unit Habitat Acreage	
Habitat	*Acres*
Riparian scrub	*714*
Riparian woodland	*2,201*
Fresh emergent wetland (marsh)	*1,270*
Seasonal wetland	*635*
Total	*4,820*

Less than 5% of the east Delta consists of riparian, oak woodland, fresh emergent wetland, and seasonal wetland habitats. Much of the riparian and permanent and seasonal wetland habitats are found along the Cosumnes and Mokelumne rivers and in the White Slough Wildlife Area.

Hydraulic processes in the east Delta are influenced by tides, river inflow, weather, channel diversions, and upstream water releases. Unimpeded tidal action into tidal wetlands affects the habitat's sediment and nutrient supplies. These supplies influence the natural marsh successional processes. Tidal outflows transport nutrients and carbon into Bay-Delta aquatic habitats. Hydraulic processes have been modified in the east Delta since the 1800s. Reductions in flow from the Mokelumne River began in the late 1800s and continued to decline into the 1960s. The DCC gates began operating in 1951 and increased the flow of Sacramento River water into the East Delta Ecological Management Unit. Hydraulic patterns have been further modified by the significant export pumping, which began in 1951 for the CVP and in 1968 for the SWP.

East Delta Ecological Management Unit Land Use	
Land Use	*Acres*
Non-flooded Ag	*58,937*
Flooded Ag	*6,054*
Orchard	*870*
Vines	*2,653*
Total cultivated	*68,514*
Grass	*10,906*
Other	*21,152*
Total	*100,572*

Current hydraulic conditions in the east Delta are unhealthy. These conditions reduce the ability of this Ecological Management Unit to provide suitable residence times and more natural net flows, to provide adequate transport flows to the central and west Delta, and to support high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

The effects of the many small unscreened diversions in the east Delta are unknown.

SOUTH DELTA ECOLOGICAL MANAGEMENT UNIT

The South Delta Ecological Management Unit is bounded on the north by the San Joaquin River, Turner Cut, Whiskey Slough, Trapper Slough, Victoria Canal, and Italian Slough. Notable features are the San Joaquin, Old, and Middle rivers; Clifton Court Forebay; and the State and federal fish protection and export facilities. Land elevations generally range from 10 feet below to 10 feet above mean sea level. Only about half of the unit is at or slightly higher than sea level.

This Ecological Management Unit consists of more than 177,000 acres. The primary land use is agriculture with more than 60% in field crops, orchards, and vineyards. Less than 2% of this Ecological Management Unit consists of riparian, oak woodland, fresh emergent wetland, and seasonal wetland habitats. Much of the riparian and wetland habitat is found in narrow bands along the San Joaquin River and on small channel islands in Old River. (See tables in this section for acreages.)